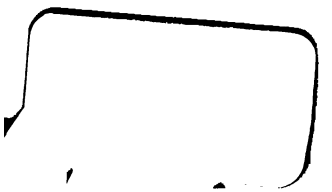

HOW TO ARREST INFECTIOUS DISEASES

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By EDGAR G. BARNES, M.D. Lond.

VICE-PRESIDENT (LATE PRESIDENT) OF THE NORWICH MEDICO-CHIRURGICAL SOCIETY; MEDICAL OFFICER OF HEALTH OF THE EYE URBAN AND HARTISMERE RURAL SANITARY DISTRICTS

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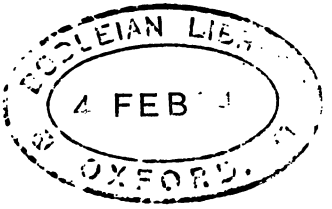
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PREFACE.

THIS little work originated in a question addressed to me by a highly valued and respected medical friend and practitioner of long standing in a neighbouring town, who, knowing that as medical officer of health of the district in which I reside I had given some attention to the subject of disinfection and the prevention of infectious diseases, asked if I could tell him of some little book which gave, in a compact form, trustworthy information of the way in which disinfectants should be used, as well as particulars of other precautions to be taken during the prevalence of such diseases, and which, whilst thus useful to the busy practitioner by supplying him with minute details, familiar enough, but apt to evade the memory just when they are wanted, should also be of such a character that he might place it in the hands of any intelligent non-medical man, as a guide to him in protecting his family from the ravages of these diseases. I was unable to give him the name of such a work, though I was able to point out where the information asked for might be found, scattered here and there in larger treatises and in papers in

the medical journals. The line of thought thus suggested led to this effort, which, whilst it lays no claim to originality, yet, I hope, fulfils to some extent the idea so expressed. The materials are collected from varied, but indisputably authentic sources, and for these I must principally acknowledge my indebtedness to Parkes' "Practical Hygiene," Quain's "Dictionary of Medicine," Ziemssen's "Cyclopædia of Medicine," Reynolds' "System of Medicine," Miller's "Elements of Chemistry," Braidwood and Vacher's "Reports on the Life History of Contagium," and numerous papers in the "Lancet," "British Medical Journal," "Medical Times," and "Sanitary Record;" in the search for which I found valuable assistance from Dr. Neale's "Medical Digest"; and the opinions I have thus gathered have been confirmed or checked by my experience as medical officer of health for the past ten years, in a small district indeed, but for that reason one specially adapted for the observation of infectious diseases, since such that occurred were so closely under my personal superintendence in their sanitary aspects. In my facts, then, I believe no serious inaccuracy will be found, whilst the opinions I have expressed would, I am convinced, be *in the main* endorsed by those who have most studied this class of diseases.

EYE, SUFFOLK, *November*, 1883.

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HOW TO ARREST INFECTIOUS DISEASES.

CHAPTER I.

INFECTION AND DISINFECTION.

WHAT is understood when we speak of certain diseases as *infectious* or *contagious*, and when we speak of *infection* and *contagion?* Strictly speaking, the latter term is more limited in its meaning than the former, since contagion (Lat. *contagio*, a touching) implies direct *contact* or touch, and a contagious disease is one propagated by contact; but popularly these two terms are frequently used as synonymous. By *infectious* we mean the property possessed by certain diseases of giving rise to the same disease in a different individual, and this influence may be exerted at some distance, and without absolute contact of the individual receiving the *infection* and the individual giving rise to it. But to what is this property due? It is due to something given off from the body of the sufferer,

in his breath, from his skin, from the secretions and excretions of his various organs, which contaminates the air around him, the room he inhabits, the clothing he wears, the bed on which he lies, and everything with which he comes into contact, even the books he reads and the letters he writes.

What, then, is this something? and what are its principal characteristics? What it is we cannot say with absolute certainty, but some of its characteristics we can tell; we know some of its habits, and from that knowledge we learn how to take precautions against it, and we learn the art of *disinfection*. As to the exact nature of infection, scientists have yet much to learn, and probably it may vary in different diseases. It may be, for example, that the infection of small-pox is not only distinct in character, as we know it must be, from that of scarlet fever, but may possibly be of another nature entirely, and have a totally different place in this world's history. From time to time, in all countries, attempts have been made, and with a certain degree of success, to unravel the mystery of infection, and various speculations as to its nature have been rife. It has been supposed to be a gaseous or liquid emanation from the infected body; or to consist of minute solid organic substances of complex composition, yet not living; or living *vegetable* organisms, such as *fungi*, similar to those which produce mould or fermentation; or organisms

forming the lowest members of the organic world, known to science as *bacilli*, *micrococci*, *bacteria*, *vibriones*, etc. All these views have had their advocates, but present scientific opinion tends strongly in favour of the bacterial nature of infection; yet the question cannot be regarded as at present finally settled, and the limits and object of this little work do not admit of its discussion.

Of its characteristics and habits we can speak more certainly. We know, for instance, that it floats in the air, and is wafted by the wind in some cases to a considerable distance; that it adheres to rooms, ceilings, and walls; that it attaches itself to bedding and clothing, and, in fact, to everything it comes in contact with; that under certain conditions it is absorbed by the water we drink and by the food we eat (milk especially seeming liable to become contaminated); that the *disease germs*, as we may conveniently call them without pledging ourselves to any definite theory of their nature, retain their infective power under some circumstances for a considerable time, and then give rise to their offspring of disease and perhaps death. For example, the author met with a case in which a cloth jacket worn by a scarlet fever patient, after being laid up without disinfection and without free access of air for twelve months, became the source of infection in a girl who then wore it; and similar

cases have been met with in the experience of many physicians. Another example may be quoted in the words of the eminent physician who observed it, and who thus writes*:—"Scarlet fever had attacked several persons in a large household; when it was fairly over the house was left empty, and then (as was supposed) most thoroughly ventilated and purified. A year afterwards the family returned to the house. A drawer in one of the bedrooms resisted for some time attempts to pull it open. It was found that a strip of flannel had got between the drawer and its frame, and had made the drawer stick. This piece of flannel the housemaid put playfully round her neck. An old nurse who was present, recognizing it as having been used for an application to the throat of one of the former subjects of scarlet fever, snatched it from her, and instantly burned it in the fire. The girl, however, soon sickened, and the disease ran a second time through the household, affecting those who had not had it on the first occasion." We know, also, that these germs, when they fall in what to them is a suitable soil, *i.e.*, the body of a susceptible individual, reproduce themselves, and by so doing reproduce the disease from which they originated. We know also that exposure to pure air in abundance, that heat, that

* Sir Thos. Watson: "Lectures on the Principles and Practice of Physic."

certain chemical agents which we call *disinfectants*, destroy the hurtful properties of these germs; and in one way or another, by losing their vitality, by chemical decomposition resolving them into simpler harmless compounds, by oxidation, by desiccation, by combustion, or in other ways, these germs cease to exist; and this process of destruction is what we aim at when we *disinfect*, and constitutes *disinfection* in the truest and widest sense, though the term *disinfectant* is often limited to chemical agents which effect this end. Who is there, that, sitting in a room, the air of which is clear and apparently unvitiated, has not been astonished when a sudden ray of sunlight has entered, and shown up myriads of particles of *dust* floating in the air in ceaseless movement, and being inhaled by every breath we draw. And when this *dust* is submitted to microscopical examination, of what is it found to consist? The list of substances actually found is thus given by Dr. Parkes*:—

Inorganic.—Silica, silicate of aluminium, carbonate and phosphate of calcium, peroxide of iron, carbon, sand, *dried mud*, chloride of sodium.

Animal.—*Débris of dead animals, germs of vibriones, bacteria and monads*, and small eggs of various kinds.

Vegetable.—Seeds and *débris* of vegetation, pollen, *spores of fungi*, etc.

* "Practical Hygiene," pp. 97 to 101.

And, in addition to these, in inhabited rooms we have *epithelium*, *portions of fibres* (*linen*, *cotton*, *wool*), portions of food, *bits of human hair*, wood and coal, and an immense amount of *organic matter*, *even pus cells*.

What a list is this! and how well it is that we should bear in mind this ordinarily invisible, impalpable dust as the type of *infection*, which it so much resembles in the tenacity with which it clings to everything it touches; in its diffusibility; in its penetrating power, whereby it enters every nook and cranny; in its power of being wafted hither and thither by every breath that blows; in its capability of entering the human body with the inspired air, with the food we eat, and with the water we drink. But here the analogy ceases. The introduction into the human body of the dust I have described is not baneful, except when introduced in such an amount as to give rise to local effects in the lungs or other recipient organs; whereas the introduction of infection produces specific disease affecting the entire body, even if introduced only in small quantity.

And when, instead of the air of a room inhabited by healthy human beings, we consider the air of a sick chamber, how suggestive does this list become! Germs of vibriones, bacteria, and monads (to which many of the ablest observers of

the present day attribute our infectious diseases); spores of fungi; epithelium, which, here, may be considered to include minute scales from the surface of the skin, as well as from mucous membranes, perchance of a scarlet fever patient; portions of fibres (linen, cotton, and wool), soaked perhaps in the perspiration or other excretions of the sufferer; bits of human hair, contaminated in like manner; even pus cells, it may be from the pustules of small-pox, or the unhealthy ulcer. Fain would one draw a curtain over the loathsome picture, were it not that this *dust* represents disease, and that the destruction of the harmful products represents disinfection.

And this is the enemy with which we have to contend; an enemy strong and subtle; one who kills, not his tens, but his hundreds of thousands annually in the British Empire; one as much to be dreaded as the horrors of a campaign; yet withal a foe invisible, and not appreciable by any of our unaided senses. And lest any one should think this an overdrawn and exaggerated picture, I would ask attention to the following figures from the Registrar-General's "Forty-third Annual Report," published in 1882, showing the number of deaths from *some of the principal* infectious diseases in England and Wales only, during the five years 1875-79; and these numbers, large as they are, are considerably below the average

annual number of deaths from these causes since 1850*:—

Disease.	Deaths Registered in England in the Years				
	1875.	1876.	1877.	1878.	1879.
Small-pox . .	950	2,408	4,278	1,856	536
Measles . . .	6,173	9,971	9,045	7,765	9,185
Scarlet fever .	20,469	16,893	14,456	18,842	17,613
Diphtheria . .	3,415	3,151	2,731	3,498	3,053
Whooping-cough . .	14,280	10,556	11,358	17,784	12,752
Typhus fever .	1,499	1,192	1,150	964	579
Typhoid fever.	8,913	7,550	6,879	7,652	5,860
Simple continued fever	2,651	2,004	1,958	1,801	1,494
Total . .	58,350	53,725	51,855	60,162	51,072

And this only represents the *deaths*. It is almost impossible to say how many cases of *sickness* these deaths represent; and of these non-fatal cases, how many have been left with their health shattered, and have been permanently hindered in the race of life? Surely no pains are too great to repel such an invader; and it is the object of this book to show the line of defence; and in the first place let us remember that it is only by painstaking attention to *minutiæ*, by care in seemingly trivial details, that we can hope for success.

* "Forty-third Annual Report of the Registrar-General of Births, Deaths, and Marriages in England," page 69, table 31, and page 79, table 34.

CHAPTER II.

PRECAUTIONS DURING THE PROGRESS OF INFECTIOUS DISEASE.

THE first essential when a case of infectious disease occurs in a house, is the *isolation* of the sufferer, which should be done *at once* in the best manner practicable. The safest and most complete form of isolation is to remove him to a hospital, or into a separate house, and to disinfect the room he occupied when the disease commenced, and everything in it, in the way described in a subsequent chapter. But if circumstances are such that he cannot be removed, the question then arises of the removal of those who are not yet visibly infected, and sometimes places can be found where they can be received without danger of spreading the disease to others. This question most frequently arises in boarding-schools, where the first impulse on the outbreak of contagious disease seems frequently to be to break up the school, and send

the pupils to their homes, and by so doing possibly to sow the disease broadcast over the country, and infect many houses. Such a practice cannot be too strongly condemned, and those who have been exposed to infection should certainly not be sent home to mix with their brothers and sisters until a sufficient time has elapsed to show whether they have received the infection or not. In my opinion, therefore, the proper plan is to divide the sufferers from the apparently healthy in a separate house, if possible; but this, of course, is usually not practicable, and fortunately complete and satisfactory isolation may frequently be accomplished without it. I have seen many cases in which one child only in a family has suffered from scarlet fever, the remaining children having been protected by precautions such as are here described; but there can be no doubt that schools, and all institutions where large numbers (especially of children) are congregated, should be provided with a detached building to serve as an infectious hospital. In the absence of such arrangements, the next thing is to choose a room in the house in which isolation can be attempted. The room chosen should be as much separate from the other rooms as circumstances permit, should be light and airy, and *well ventilated*, and provided with a fireplace, useful, if not required for warmth, to assist the ventilation; and this room should be

still further isolated by suspending on the landing outside the door, so as to cover the doorway completely, a sheet, which should be kept constantly moistened with a solution of some disinfectant, such as carbolic acid, chloride of lime, or Burnett's fluid.* The room should next be stripped of every article of furniture that is not necessary for the use of the sufferer, in order that the things capable of retaining infection, and therefore requiring disinfection, may be reduced to the lowest possible number. To this end, carpets, curtains, bed-hangings, toilet mats, and the many little nicknacks to be found in bedrooms should be removed, together with dresses, linen, and other articles from wardrobes, drawers, closets, etc., in the room; and in deciding which things should be allowed to remain, it should be remembered that *everything* which remains will require disinfection in some form, and that things capable of being washed and boiled, and things with little or no colour in them, can be best disinfected without permanent damage, and that things of a woolly nature, furs, etc., are more likely to retain infection than linen or cotton. Next, the patient must have an attendant, or in a severe case perhaps two, who should preferably be persons who have

* The strength of solution to be used for these and other purposes will be found in a subsequent chapter under the name of the disinfectant.

previously had the disease; and these attendants should as much as possible avoid contact with others in the house, taking their meals by themselves in a room adjoining that of the patient, and having everything they require brought to them to convey to the patient; especially should they avoid contact with the children and young persons in the house, these being more susceptible of infection than older persons. At the same time they must not be entirely confined to the sick room, as it is essential to their health that they should take daily exercise in the open air. In these days, fortunately, nurses experienced in the management of infectious cases may be obtained from the excellent nursing institutions in most of our large towns. They should wear dresses of print or other washing material, and should be careful to wash their hands frequently, especially after attending on the patient, one of the disinfecting soaps being used for that purpose. They should be scrupulously careful of the cleanliness of the sick room and everything in it, and its proper ventilation should be deemed a matter of vital importance, doors and windows being as freely opened as is consistent with the safety of the patient, due regard being given to the temperature of the external air and other atmospheric conditions. By so doing the infection is diluted and carried away, and the disease germs are

subjected to the best of all disinfectants—the oxygen and ozone of the air.

We have next to consider the use of so-called *aerial* disinfectants, that is, of volatile substances distributed about the sick room in various ways with the idea of destroying disease germs in the air. It is somewhat the fashion nowadays to decry their use, and by stating what I believe to be an undoubted fact, that air so impregnated with disinfectants as to be destructive of disease germs is irrespirable by man, to discredit their use and to discard them altogether. Yet this, I think, is an error; for though by their use you cannot make an infected atmosphere pure and safe without rendering it destructive to the sufferer as well, yet an atmosphere impregnated, *e.g.*, with chlorine, to as great an extent as can be borne without discomfort, is surely unfavourable to the activity of disease germs, and is certainly destructive to effluvia evident to the sense of smell which proceeds from such sufferers, and which, consisting as they do of complex organic compounds, form an environment which favours the activity of infection, and tends to prolong its power of evil. From these considerations I think the use of aerial disinfectants rests on a sound scientific basis, and should always be practised, but only to such an extent as not to interfere with the comfort of the patient. The only danger seems

that, unless the fact already mentioned is kept clearly in view, they may engender a feeling of false security, and may lead to the omission of the more vital matters of isolation, cleanliness, ventilation, and thorough disinfection afterwards. Bearing these points, therefore, steadily in our minds, we should use disinfectants freely in the sick room, placed about in saucers, sprayed into the air with spray-producers made for the purpose, and sold by surgical instrument makers and chemists, sprinkled about the floors, or caused to evaporate into the air from cloths saturated with them and hung about the room, the best disinfectants for this purpose being those previously enumerated for the sheet outside, and they should also be used in the same way for the landing or passage connecting the sick room with the rest of the house.

All excretions from the sufferer should be received into vessels containing disinfectants, and all linen from the bed or body of the patient should be immersed in water containing carbolic acid or Sir Wm. Burnett's fluid. For this purpose a tub filled with disinfecting solution should be placed in the room, and all linen should be immersed in it immediately on removal from the patient, and allowed to soak some hours before washing. It should not even then be sent to the laundry to be washed with other linen.

Earthenware and glass vessels, spoons, forks, etc., used by the patient, are best disinfected by washing in water containing Condy's fluid.

Visits of friends and relatives should be prohibited, unless such visits are rendered imperative by exceptional circumstances, and then should be as few and short as can possibly be, it being always remembered that such visits constitute a weak point in our defences.

Another valuable means of preventing the diffusion of infection into the air of the apartment consists in sponging the patient's entire body with warm water, or washing it with soap and water, one of the disinfecting soaps being used for this purpose. This should always be done before a convalescent is allowed to mix with susceptible persons, no part of the body being omitted from repeated washing, the hair especially being liable to retain infection. The author has quite recently met with a case in which otherwise complete precautions were rendered nugatory by the mother omitting to wash the head of a child convalescent from scarlatina before allowing him to mix with his brothers. This sponging and washing may also be frequently resorted to during the progress of the disease, not only preventing infection, but being a comfort and benefit to the sufferer. But before this is done, medical advice must always be sought

to ascertain if it be proper in each individual case, the answer depending on the constitution of the patient, the stage of the disease from which he is suffering, the atmospheric conditions, etc. During convalescence the same precautions must be maintained until infection ceases, everything with which the convalescent comes into contact, the clothes he wears, and the rooms he inhabits requiring subsequent disinfection. And convalescence is frequently the most difficult period during which to maintain efficient sanitary precautions. The sufferer feeling now well complains of the monotony of seclusion from his family and friends, and requires amusement. Outdoor exercise will perhaps be permitted by his medical attendant, but amusement must be provided when indoors, and here it must be remembered that infection is still existing, and toys, books, and work must be provided of a suitable character. In these days of cheap literature there is no difficulty in obtaining for a few shillings judiciously expended sufficient books to mitigate the irksomeness of the necessary restraint, which can afterwards be destroyed, and the same remark applies to toys, whilst for ladies fancy work can be readily obtained of such a character that it can be disinfected in the same way as the clothing and bed-linen. And here let me raise my voice against the selfish practice of

removing convalescents *whilst still infectious* to the seaside "to shake off their infection." How often do we see a convalescent, commonly from scarlet fever, who is not considered safe to mix with his own family, put into a cab and sent to a railway station, thence in a first-class carriage (with its cloth or velvet linings ready to catch up infection) to a seaport town, and thence in another cab to lodgings until he is safe to return to his own family. And all this to the danger of those who may chance to occupy those cabs, that railway carriage, or those lodgings after him. And this risk is run merely to save a few days' extra seclusion. In my opinion the maxim ought to be clearly laid down that he who is not safe to mix with the members of his own household is not safe to travel or to go into lodgings. And here let me warn those who practise this thoughtless procedure, that by so doing they offend against the law and render themselves liable to penalties; and let me commend to their attention the quotations from the Public Health Act contained in the last chapter of this book relating to the conveyance of infected persons. Under the head of each disease in the next chapter will be found a few observations on the period to which infection extends, and when convalescents may be considered safe to travel and to mix with others.

Another common fallacy is frequently heard, and is generally expressed to the medical attendant in the form of a question, thus:—"Do you think, doctor, it is worth while taking all this trouble to prevent the other children having it? They are sure to have it one day, and it is a mild form, and the sooner it is over the better." To this my reply is, yes, it certainly is worth while, and it is your duty to take precautions. Isolation is in many cases not impracticable, and is frequently successful in preventing the spread of the disease. The children are not sure to have it, as many persons pass through life without contracting it; and as to its being a mild form, it does not by any means follow that, though the first case is mild, subsequent ones are equally so, for it is in the experience of every medical man that a mild disease in one may give rise in another to the same disease in a most virulent form; and I little envy the feelings of that parent who, after having, through carelessness, or to save trouble, exposed his children to what seemed to him a mild disease, sees, as it may well be in the case of scarlet fever, one die of its malignant form, another die of kidney disease supervening on a very mild attack which he has regarded with satisfaction as "getting it well over," and another rendered permanently deaf by disease of the ear, which so frequently follows

even mild cases; or, in the case of measles, the seeds of chronic bronchitis, or even consumption, may be laid by a mild attack thus wantonly contracted. These things are painful enough when unavoidable, but how much more so when brought on in the way I have described. How true it is, "men have evils beyond destiny through their own foolishness."

When an infectious disease exists in a family, the children who may not be suffering should be kept from school and from other places where children especially are apt to congregate.

In case of death from infectious disease, the body should be washed with disinfecting soap and water, and should be placed in the coffin and buried with as little delay as circumstances allow. The bottom of the coffin should be sprinkled with chloride of lime or McDougall's powder, or covered with a thick layer of sawdust saturated with Sir Wm. Burnett's fluid, or carbolic acid. The funeral arrangements should be simple, and as few people as possible brought into contact with the coffin. The practice, which the author has known carried out, of having a child who has died of infectious disease carried to the grave by her schoolfellows should be strictly prohibited.

All carriages which may have been used for the conveyance of persons suffering from

infectious disease should be carefully disinfected before being again used,* and during the prevalence of such diseases all water-closets and drains should be daily flushed with solution of sulphate of iron, carbolic acid, Burnett's fluid, or some similar disinfectant. Manure heaps and accumulations of offensive matter should be treated in the same way until they can be entirely removed.

* Carriages are best disinfected by sulphur-fumigation, unless the cushions and stuffing are removable, so as to be exposed to hot air.

CHAPTER III.

MANAGEMENT OF SPECIAL DISEASES.

Small-pox (*Variola*). — In this disease the infection principally arises from the breath, skin, and excretions of the sufferer. The infection is very intense, but does not seem to last for so long a period as that of scarlet fever. It may very readily be conveyed, especially by the discharges from the pustules, which soak into linen and clothing; and by the dried crusts in process of separation. Hence special attention should be paid in this disease to the cleansing of the skin by baths, and to the disinfection of the bed and body linen. It may also be readily conveyed by the clothing of persons in attendance on the sufferer.

In this disease we possess, fortunately, another potent safeguard, viz., *vaccination*. All inmates of the affected house should at once be vaccinated, whether they have been submitted to the operation

in infancy or not. Of the efficiency of vaccination as a protection against small-pox, abundant evidence has from time to time been cited; but the limits of this work only allow a few striking facts to be stated, its protective power being shown both in the reduction in the number of cases and in diminishing its mortality, and this diminished mortality is directly in proportion to the perfection of the vaccination, as evidenced by the marks or cicatrices on the arm. These facts are set forth in the following tables:—

Periods compared.	Annual Death-rate from Small-pox per Million of Population.
Average of thirty years previous to introduction of vaccination, estimated by Dr. Lettsom and Sir Gilbert Blane*. . . .	3,000
Vaccination optional, 1847-53†.	305
Vaccination obligatory, but not efficiently enforced, 1854-71† . . .	223
Vaccination obligatory, and more efficiently enforced by vaccination officers, 1872-80† . . .	156

* Reynolds' "System of Medicine," vol. i. Art. "Vaccination," by E. C. Seaton, M.D.

† "Forty-third Annual Report of Registrar-General," p. 22.

At the London Small-pox Hospital over 15,000 cases of small-pox came under the care of Mr. Marson during thirty years' experience, and the death-rate amongst the vaccinated and unvaccinated is thus recorded*:—

Classification of Patients Affected by Small-pox.	Number of Deaths per cent.
1. Unvaccinated	35·00
2. Stated to have been vaccinated, but having no cicatrix	23·57
3. Vaccinated—	
a. Having one vaccine cicatrix	7·73
b. Having two vaccine cicatrices . . .	4·70
c. Having three vaccine cicatrices . . .	1·95
d. Having four or more cicatrices. . . .	0·55
α. Having well-marked cicatrices. . . .	2·52
β. Having badly-marked cicatrices. . . .	8·82
4. Having previously had small-pox	19·00

The experience of small-pox hospitals, where the attendants are invariably revaccinated when first entering on their duties, is uniformly that small-pox after *successful* revaccination is almost unknown.

Period of Incubation.—The period which elapses between the reception of the infection and the

* Reynolds' "System of Medicine," vol. i. Art. "Vaccination," by E. C. Seaton, M.D.

development of the eruption is fourteen days. This period is sometimes, but rarely, somewhat shortened when the recipient has been previously vaccinated. It is never exceeded, so that a person who has been exposed to small-pox infection may be considered safe if fifteen days have elapsed without the eruption appearing.

The *period during which infection exists* commences with the first symptoms ere the rash appears, and continues as long as any of the crusts remain undetached from the body, which is usually about three weeks.

Scarlet Fever (*Scarlatina*).—This disease is extremely infectious, though, perhaps, less so than small-pox, and the infection is peculiarly liable to lay up for lengthened periods in clothing, etc. It arises principally from the breath, skin, and excretions of the sufferer, being probably greatest during the period of desquamation or peeling of the skin, which usually, in a greater or less degree, follows this disease. Special attention should therefore be paid to the disinfection of the skin by warm baths, or by sponging with tepid water, or by anointing the skin with carbolized oil (one part carbolic acid in forty parts olive oil), a proceeding recommended by Dr. William Budd as a means, not only of disinfecting the skin, but of preventing the pieces of cuticle loosened by the desquamative process passing

into and infecting the air. Even the mode of making the bed of a scarlet fever patient is of importance. In the desquamative stage, the sheets between which the patient lies will be seen to be covered, often thickly, with minute particles of cuticle (containing the contagium, of whatever nature it may be), and the usual practice in bed-making is to throw these sheets off suddenly over the foot of the bed, by which means the desquamated particles are flung into the air of the room. How much better to fold the sheets gently together and remove them (cuticle and all) into the tub of disinfectant which should be ready to receive them. This point used to be insisted on by the late Dr. H. W. Fuller, of St. George's Hospital, and I am convinced the practice is a most salutary one.

The *period of incubation* is very variable, as is illustrated by the following cases which have come within my experience :—

1. A woman sat with her sister, who was suffering from scarlet fever, the whole of one afternoon, this being the only time she had any communication with her, directly or indirectly. She developed the disease next morning (twelve hours after).

2. A woman went to London from the country, and slept in the same bed which had been occupied by a scarlet fever patient. She developed the

disease in thirty-six hours after going to bed, and within forty-eight hours of entering the infected house.

3. A boy at school slept in the same room as a scarlet fever patient, was sent home and carefully isolated, so that it seemed no other chance of receiving the infection could occur from that or any other source. He did not develop the disease until the twenty-second day.

Similar cases to this last have been occasionally observed, but they are so rare as always to give rise to the suspicion that, in some unobserved way, exposure to infection has again occurred. As a general rule, the period of incubation is about three days, or seventy-two hours; but frequent exceptions occur, so that it may be stated to vary from a few hours to seven days, the cases in which the time is thought to be extended beyond this being extremely rare. Therefore, it is usually safe for a child who has been exposed to infection to mix with his fellows after a week has expired, provided he does not do so in clothing which has also been exposed, and which is liable to retain the infection longer.

The *period during which scarlet fever is infectious* commences with the fever and sore throat, and terminates with the completion of desquamation, one month from the onset in mild, six to eight weeks in severe cases.

And here let me warn any non-medical reader not to be misled by the term *scarlatina*, which many suppose to be a milder disease than scarlet fever. The two names are absolutely and entirely synonymous, and scarlatina is only scarlet fever under a Latinized *nom de plume*.

It is also recommended in cases of scarlet fever to wash the throat with a solution of sulphurous acid, or diluted Condy's fluid, or solution of chlorinated soda diluted with ten parts of water, or other disinfectant; but this, as well as the application of carbolized oil to the skin, are measures only to be undertaken by the advice of the medical attendant.

Measles (*Morbilli, Rubeola*).—The infection in measles is similar in nature, but not so intense as in scarlet fever, and the special precautions required are similar.

The *period of incubation* of measles is usually twelve days from the reception of infection to the appearance of the rash, the premonitory catarrhal symptoms appearing three or four days previously. It may occasionally be prolonged a few days. The *period of infectiousness* commences with the sneezing, watering of the eyes, and other symptoms similar to a "cold in the head," which precede the rash, and terminates in about a month.

German Measles (*Rötheln, Rubella*).—This

disease is propagated in much the same manner as scarlet fever and measles. The *period of incubation* is longer than in those diseases, being usually fourteen and sometimes twenty-one days. The *infectious period* commences with the earliest symptoms, but probably terminates within about ten days or a fortnight after the disappearance of the rash. It is necessary to bear in mind that an attack of German measles is not a preventive of an attack of measles or of scarlet fever, and there is reason to believe that many popularly reported examples of a second attack of measles are in reality an attack of measles succeeding German measles, or *vice versâ*.

Whooping-Cough (*Pertussis*).—The *infection* of whooping-cough is principally given off in the breath of the patient, though probably, as in all infectious diseases, the skin and excretions may convey the disease. It may readily be conveyed by clothing. It is very difficult to isolate owing to the intensity of the contagium and the length of the disease, and, as a consequence, is so prevalent that few persons escape it in childhood.

Its *period of incubation* extends from four or five days to a fortnight. It is infectious from the first symptoms of cough, before the characteristic whoop is developed, and continues so probably for eight or more weeks. Sufferers from whooping-cough frequently have a kind of irritative cough, persisting

after the true whooping-cough is gone, which makes it difficult, if not impossible, to determine with precision when they may safely mix with others.

Diphtheria.—The *infection* of diphtheria arises in part from the skin and excretions, but the breath is probably the principal vehicle of contagium, with the exception of the false membrane and discharges from the mouth and throat, which are peculiarly virulent; hence it is wise to avoid the use of pocket handkerchiefs and substitute pieces of rag, which may be burned as soon as used. Particular care is required in cleansing vessels used in drinking, and forks and spoons used in eating, and spoons or other instruments used by the medical attendant in examining the throat: all these should be immediately immersed in boiling water, and then washed in water containing Condy's fluid. With the exception of these discharges, the infection is not so intense as that of small-pox or scarlet fever. Disinfectant applications may be used for the throat, as in scarlet fever, under medical advice only. The *period of incubation* is generally from one or two to ten days; but persons who have been exposed to infection should not be considered to have certainly escaped until fourteen days have elapsed. The *period during which the infection prevails* commences with the earliest symptoms, and continues in some cases at least for several weeks.

Dr. William Ogle has recorded* an instance in which the disease was communicated after four weeks' freedom from illness, and another in which the same result followed after ten weeks. Since reading his article I have come across a similar instance, in which infection resulted more than one month after convalescence. In all these cases, however, there is a possibility of the infection being retained on the clothing rather than by the sufferer; and it is probable that, in cases in which due care has been taken by personal disinfection and disinfection of clothing, one month after convalescence is the period when isolation may safely cease.

Typhus Fever.—The *infection* in this disease is somewhat intense, but does not extend to any great distance from the patient, and is not readily conveyed by means of attendants, etc. Hence the disease is easily isolated, though it spreads with great rapidity amongst the crowded tenements of the poor in towns. It resides chiefly in the breath and exhalations from the skin, and clings about the patient, his bed, and his clothing. The special precautions consist in taking great care to secure abundance of fresh air, and careful and thorough disinfection of bed-linen and clothing.

The *period of incubation* is generally about a week, and does not exceed fourteen days.

* "St. George's Hospital Reports," vol. ix. p. 709.

The *infective period* commences with the first symptoms, and terminates as soon as convalescence is fairly established.

Typhoid Fever (*Enteric Fever, Gastric Fever*).—The principal *infection* in this disease resides in the evacuations from the bowels; and though the exhalations of the skin and the breath are also infectious, they are so in a mild degree compared with the diseases we have already considered. The fever is frequently propagated by these discharges finding their way from cesspools through the soil into wells used for the supply of drinking-water, therefore great attention should be given to their proper disinfection; they should be received into vessels containing a liberal supply of disinfectant, and should be covered before removal from the patient's room. In towns they must be emptied into the sewage system, which should be kept frequently flushed with disinfectant solution; but in country places where the arrangements for flushing are not so perfect, it is best to bury them in the earth in the garden, special care being taken to put them away from the well. The distance that it is necessary to put them away varies with the nature of the soil; but in my opinion twenty yards is not too much to insist on under the best of circumstances. The disinfectants most to be recommended for disinfecting

bowel discharges are chloride of zinc, sulphate of zinc, sulphate of copper, sulphate of iron, and carbolic acid. Special care should be taken to disinfect the bedding, which is so often soiled with the discharges from the patient. The *period of incubation* is from five to fourteen days, and *infection* commences with the onset of the fever, and continues until all diarrhœa has ceased, and convalescence is established.

Cholera (*Asiatic Cholera*).—The remarks made under the heading of typhoid fever with respect to the infectious nature of the evacuations, and the precautions to be taken, apply with equal force to this disease.

The bed on which a patient lies who is suffering from Asiatic cholera should invariably be burned, as it is sure to be saturated with infectious evacuations.

The *period of incubation* never seems to exceed five days. The disease is infectious from the first symptoms until the bowel evacuations have become natural.

Chicken-pox (*Varicella, Water-pox*).—Chicken-pox is so mild a disease that it does not call for special sanitary precautions.

Its *period of incubation* is thirteen days, and it is *infectious* from the appearance of the eruption until the disappearance of the resulting scabs.

Mumps (*Parotitis*).—This disease calls for no

sanitary precautions, except the separation of those affected from the healthy.

The *period of incubation* varies from eight days to three weeks, and it is infectious from the commencement of the disease until perhaps a fortnight after the subsidence of the affection of the glands.

Some other diseases, such as *erysipelas*, *puerperal fever*, and *diarrhœa*, may call for the use of disinfectants on some occasions, but they need not occupy special attention here, as the way in which they should be used has been sufficiently indicated in speaking of other diseases.

In the case of ordinary non-infectious sickness, the use of one of the more agreeable disinfectants, such as *sanitas*, or solution of chloride of lead, is often grateful to the patient, and helps to preserve the purity of the air.

CHAPTER IV.

DISINFECTION AFTER THE TERMINATION OF THE DISEASE.

After the termination of the case, whether by recovery or by death, it is necessary that the rooms the sufferer has inhabited, his clothing, and *everything* with which he has come in contact should be thoroughly disinfected; and this process must be carried out *minutely*, bearing in mind the fact that disease germs, unless destroyed, may lie dormant for many months, and then give rise to the disease from which they originated. This disinfection may be carried out as described under the following headings:—

Rooms should be fumigated with sulphur or with chlorine gas, any clothing or other materials which it may be advisable to submit to the same process being spread about the room or suspended from strings in it. It should be kept closed for *four hours to allow* the disinfecting fumes to

penetrate every portion of it, and should then be opened freely to the air to get rid of the smell of the fumigating agent. On the whole, the fumes of burning sulphur are the most efficacious, and have less effect on delicate colours than chlorine. The *ceilings* of the rooms should be well scraped and washed and whitened afresh, and whitewashed and distempered *walls* should be treated in the same way.

The answer to the question as to whether the *paper* should be stripped from the walls, depends on circumstances:—

1. If the paper is what is called a "flock" paper—*i.e.*, a paper with a raised pattern and a certain degree of roughness—it should be stripped off, as such a paper is liable to retain infection, and cannot properly be cleansed.

2. In cases of small-pox and malignant cases of scarlet fever the paper should be stripped off.

3. In rooms in which the paper is cracked in places, and separated at the angles and corners of the room, so as to form crevices in which infectious dust may bide, it should be stripped off.

4. In cases of simple mild scarlet fever and other diseases, except small-pox, when the paper is smooth and free from cracks, the stripping off may be dispensed with, provided the room is freely fumigated, and the paper afterwards brushed down in every part with a cloth.

Wood-work and *painted surfaces* may be washed with soap and water, for which purpose one of the disinfectant soaps may be used. A combination of soft soap and carbolic acid is made specially, and is very suitable.

Articles made of *metal* and *glass* or *glazed earthenware*, having non-absorbent surfaces, are sufficiently disinfected by careful washing.

Beds, *mattresses*, etc., are best disinfected by hot air. This, however, to be properly carried out requires a *disinfecting chamber*, a somewhat costly apparatus, whereby the heat is regulated so as to ensure disinfection without destruction of the fabric. For this purpose a heat of about 250° F. is required. This, however, should not be exceeded, but should be maintained for two hours, in order that the heat may penetrate the interior. If taken in pieces, a shorter exposure is sufficient. Baking in an oven is a rough mode of attaining the same end, but it is difficult or impossible to regulate the temperature with sufficient exactitude. In the absence of any heating apparatus, the disinfection may be accomplished by allowing them to remain in the room during fumigation. This, however, is objectionable, as they require subsequently a prolonged exposure to the air to get rid of the smell of the fumigating agent. This process, *in the case* of sulphur fumigation, is much

facilitated by spreading the bed or mattress in front of a large fire for some hours.

Beds and mattresses which have been soaked with discharges from the patient, especially with the excreta from typhoid fever and cholera, should be destroyed.

Linen, *calico*, *curtains*, *blankets*, *counterpanes*, *clothing*, etc., should be disinfected by hot air. But if no proper chamber for this purpose be available, then such things as will wash without injury should be first soaked in a disinfecting solution (carbolic acid, chloride of zinc, hydrochloric acid, etc.) for twenty-four hours, and then washed and (when the fabric will allow it) boiled. Things which will not wash without injury should be suspended in the chamber during the process of fumigation, and then exposed freely to the air. In submitting coloured materials to the action of a disinfecting solution, care should be taken not to soak them in the same vessel as those which do not possess much colour, as the dye is not always fixed.

Carpets should be removed from the room so as not to become infected. Should they have been exposed, they may be disinfected by remaining in the room during fumigation, or they may be scrubbed with a solution of carbolic acid.

Books used by patients and convalescents are liable to become infected on every page, and it is

almost impossible to disinfect them efficiently. The only means of doing so is by heat, and it is difficult to heat them through sufficiently without charring the outside. Cheap literature should therefore be provided, and committed to the flames afterwards.

Toys should either be destroyed or disinfected, according to the material of which they are made.

Ladies' work should be disinfected in the ways recommended for linen, clothing, etc.

Sinks and water-closets may be disinfected by pouring down, night and morning, a pint of a solution of carbolic acid, sulphate or chloride of iron, or sulphate or chloride of zinc.

But here let me remark, that the use of disinfectants in water-closets and sinks is only to be habitually had recourse to during infectious diseases. At any time their occasional use is beneficial, but if a water-closet or sink requires the habitual use of disinfectants to obviate smell and annoyance, it may be confidently asserted that its construction is somewhere defective, and the sooner it is remedied the better. It is far wiser to send for the plumber at once, instead of hiding the defect by the use of disinfectants.

Cesspools which receive drainage from an infected house should invariably be thoroughly cleansed, a pint of solution of carbolic acid, or of the iron or zinc salts above mentioned, being added to each cubic foot of contents.

CHAPTER V.

DISINFECTANTS, AND HOW TO USE THEM.

By a *disinfectant* is meant a substance which destroys that property of certain diseases whereby they are capable of reproducing themselves in persons exposed to their influence. Most disinfectants are also *antiseptics*, *i.e.*, they arrest fermentation and those putrefactive changes which constitute decomposition; and they are also *deodorants*, *i.e.*, they possess the property of destroying odours.

Disinfectants act in various ways: by desiccation or drying; by oxidation, *i.e.*, by supplying oxygen to the deleterious substances, and thus converting them into simpler and innocuous compounds; and by decomposition or destruction of the germs or principles of infection. It is probable, too, that some disinfectants merely suspend temporarily the activity of the germs, which returns when the disinfectant ceases to act.

Disinfectants may be used in infectious diseases in three ways with advantage. First, to deodorize offensive materials; for though it is to be remembered that no evidence exists that offensive smells constitute infection, or that disease germs have any smell whatever, yet offensive smells are believed on good evidence to provide a medium for intensifying and propagating infection, and should be destroyed by suitable disinfectants. Yet this is not enough; the disinfectant has its use as a temporary expedient, but if used permanently to an offensive sewer or cesspool, may really be productive of harm by diverting attention from the real cause of offence, which, it may be depended on, resides in faulty construction whenever it frequently recurs. In such cases a builder or plumber, who understands his work, is far more valuable than tons of disinfectants. Secondly, they are of use, or such of them as are diffusible and merit the title of *aerial* disinfectants, in assisting to maintain the purity of the air of the sick chamber, and so lessen the risk of infection spreading, though they cannot abolish this risk. But here again a caution is necessary. If disinfectants are used in such a way as to lead us to forget the abundant use of nature's great disinfectant, the oxygen of the air, and make us neglect the most free and perfect ventilation *practicable, they* do more harm than good.

Thirdly, and here there is less risk of their abuse, they are useful in concentrated forms for the destruction of disease germs in empty rooms, linen, excreta, etc.; but this mode of using them cannot be had recourse to until the patient is able to be removed, as disinfectants which destroy disease germs also destroy human life. Numbers of disinfecting agents are constantly offered to the public, and new ones almost daily arise; all probably possess some power, but some are mere deodorants and not true disinfectants, and many of them, if employed according to the directions on the labels, are almost useless, owing to the great degree of dilution which is advised. In this chapter will be found a short account of the principal disinfectants, including the older forms, and those with which I have become most familiar; but it is not intended to convey the idea that a disinfectant omitted from this list must of necessity be worthless.

Heat.—Dry heat properly applied is one of the most powerful disinfectants. For its thoroughly effective use a special chamber is required, heated by coal or gas, and provided with appliances for registering and regulating the intensity of the heat. Wooden supports are provided for the things to be disinfected, which must not come in contact with the walls of the chamber. Such chambers are provided by many sanitary

authorities for use in their districts, and it is extremely desirable that such provision should be uniformly made. A rough mode of applying dry heat is by baking the things to be disinfected in an oven, but it is almost impossible to regulate the heat with such accuracy that every part of a thick substance, like a mattress, shall be sufficiently heated to ensure disinfection, whilst no part is injured by excessive heat.

The temperature to which infected articles should be exposed should range from 220° F. (104·5 C.) to 250° F. (121·1 C.). This heat continued for one hour is sufficient for linen, clothing, etc., whilst thick substances, such as beds, mattresses, etc., should be exposed for two hours. Dr. P. M. Braidwood and Mr. F. Vacher, in their report on the life-history of contagium,* state, as a result of their experiments, that a temperature of 149·5° F. (65·2° C.) deprives vaccine lymph of its specific properties, and that it is nearly the lowest temperature that can be relied on to have this effect. Other contagia, especially those enclosed in particles of epidermis, probably require a higher temperature. If the temperature is properly regulated it does not injure the fabric, and only affects very delicate colours. If the heat reaches 260° F. (126·6° C.), some fabrics

* "*British* Medical Journal," 1876, 1873, and 1882.

begin to scorch, and leather (boots, etc.) is damaged by a heat of 245° F. (118·3° C.). Dry heat is used for the disinfection of beds, mattresses, blankets, counterpanes, linen and calico, woollen materials, clothing of all kinds, wool, feathers, hair, etc.

Boiling is also an extremely useful mode of applying heat for disinfecting purposes. By this process a moist and uniform heat of 212° F. (100° C.) is obtained; but it is obvious that many things cannot be submitted to this process; and it is probable that the higher temperature attainable in a disinfecting chamber is desirable whenever such an apparatus is accessible. Hence it is well that all articles which it is intended to disinfect by boiling, should also be previously soaked in some disinfecting solution. This mode of disinfection is used principally for cotton and linen fabrics.

Fresh Air—Oxygen.—No more effectual disinfectant can be found than free exposure to a current of fresh air. This acts partly by carrying away and diluting the infection, and partly by the oxygen, which forms 21 per cent. by volume of the atmosphere, combining chemically with the infectious material, and rendering it innocuous. Hence the great advantage derived by the free ventilation of the sick room (draughts which might prove dangerous to the patient

being avoided); and the free exposure of infected materials to the winds of heaven.

Ozone is a modification of oxygen existing in the air (especially after thunder-storms) in minute quantities, and is a very powerful oxidizing agent. It is absent from the air of towns. Though it seems to be a reliable disinfectant, it has hardly yet been brought within the range of practical sanitation. It may be artificially generated in rooms by heating a platinum wire by means of a Bunsen's cell, by the exposure of a slightly moistened stick of phosphorus, or by mixing equal bulks of strong sulphuric acid and a solution of permanganate of potash (1 in 10).

Braidwood and Vacher found that exposure to oxygen gas for one day, and to ozone for a few hours, destroyed the activity of vaccine lymph.

Peroxide of Hydrogen is a good disinfectant; it deteriorates by keeping, and is scarcely known in a reliable form outside the laboratory of the chemist. It is not therefore practically useful.

Sulphurous Acid (*Sulphur Dioxide*) is the product of burning sulphur, and is one of the most reliable disinfectants we possess. It is irrespirable if existing in the air to such an amount as to be efficient as a disinfectant, and is therefore useless in the sick chamber; but for disinfecting the room afterwards, and such articles *of furniture,* clothing, etc., as cannot be con-

veniently exposed to heat or soaked in a liquid disinfectant, it is invaluable. It is best used in the following manner:—Carefully close all doors and windows, the latter being tightly shut, but left unfastened so that they may be opened from outside. The chimney also should not be forgotten, and all crevices should be closed, which may conveniently be done by pasting strips of paper over them. Any articles of clothing, bedding, etc., that it may be desirable to disinfect should be hung about the room suspended on strings, etc., so that the fumes of the burning sulphur can freely reach them on all sides. A tub or other vessel containing a little water should then be placed in the centre of the room (if the room is large, two or more tubs should be used), and across this two wooden splines should be placed to support an iron vessel (an old iron saucepan will do well) containing the sulphur. The object of the tub of water is to obviate any risk of fire or damage by the sulphur boiling over during combustion, and to catch any small fragments which are apt to fly over the sides of the pan when it is first ignited. A little methylated spirit is then to be poured over the sulphur and a lighted match applied, or the sulphur may be ignited by putting a few coals red hot from a fire into the pan. The operator should then, as soon as he has satisfied himself

that it is fairly burning, leave the room and close the door, pasting the keyhole and crevices over with strips of paper on the outside to prevent the fumes of the sulphur (which are very penetrating) reaching other parts of the house. The room should be kept closed three or four hours, by which time the sulphur should be completely burned out. The windows are then to be opened from the outside and the fumes allowed to escape. The cleaning of the ceiling, walls, etc., may then be proceeded with, the doors and windows being kept open till the odour of the sulphur disappears, and any articles which have been fumigated in the room should be freely exposed to the air for the same purpose. The sulphur to be used is the ordinary roll brimstone of commerce, roughly broken up, and the quantity which should be employed is one pound to every thousand cubic feet of air in the room.*

Sulphur fumigation is also sometimes carried out by burning *carbon disulphide*, the products of combustion being sulphurous acid and carbonic acid gases. This plan, however, is not to be recommended; it is more expensive, and the carbon disulphide is a volatile liquid, the fumes

* The cubical capacity of a room is ascertained by multiplying the length by the breadth, and the resulting product by the *height, all the measurements* being taken in feet.

of which are intensely poisonous, combustible, and dangerous.

Sulphurous acid fumes act on bright metals and kill plants; these, therefore, should be removed from the room before fumigation. It is well also to remove mirrors, lest the fumes of the burning sulphur should penetrate crevices in their backs and act on the silvering. If the air of the room be not very damp the colour of the bed hangings, curtains, etc., will not suffer, unless they are very delicate. Furniture, etc., is quite uninjured.

Braidwood and Vacher found that sulphurous acid in solution and the fumes of ignited sulphur were both utterly destructive to the specific properties of vaccine lymph, and Dr. Baxter obtained a similar result. Sulphurous acid and chlorine, and sulphurous acid and permanganate of potassium (Condy's fluid) are chemically incompatible, and should not therefore be used in conjunction.

Sporokton is a strong solution of chloride of zinc saturated with sulphurous acid gas to such an extent that one pint of the liquid contains ten gallons of gas, which it gives off freely on exposure to the air. Small quantities of sporokton placed about the room give off the gas in such a way that it may be respired without discomfort, but the odour is objectionable

to most persons. It is also used for fumigating purposes, but for this purpose does not possess any advantage over burning sulphur. The author found that vaccine exposed for five minutes to the vapour of sporokton was rendered completely inert.

Nitrous fumes are efficient disinfectants if used in abundance, but they are very destructive to furniture, bright metallic surfaces, etc., and if inhaled are dangerous to life; air containing nitrous fumes only to such an extent as not to cause discomfort at the time of inhalation, having proved subsequently fatal from the irritating effects of the gases on the lungs. They should, therefore, be used with extreme caution, and only by those who are fully acquainted with their nature and properties. These fumes consist chiefly of peroxide of nitrogen, and are obtained by adding bits of copper to strong nitric acid diluted with twice its bulk of water in an open vessel. These fumes also act injuriously on the walls and ceilings of rooms by forming a deliquescent compound with the lime contained in mortar, whitewash, or colouring.

Chlorine gas is used for fumigating rooms instead of sulphurous acid fumes, and thus used is an efficient disinfectant; but it possesses greater bleaching power and is, therefore, more injurious to the colour of curtains, hangings, furniture, etc.

It also acts injuriously on metallic objects. In a less concentrated form it is useful in the sick chamber, but is then employed principally in the form of chloride of lime.

For fumigating purposes, metallic objects, mirrors, things of delicate colour, and plants should be removed from the room, which should be closed in the same way as is directed for sulphur fumigation, and chlorine gas should be generated in one of the following ways:—

1. Mix in an earthen vessel one part by weight of black oxide of manganese and four parts of concentrated hydrochloric acid. Half a pound of the black oxide should be used for every hundred cubic feet of air to be disinfected.

2. To equal weights of black oxide of manganese and common salt add two parts of oil of vitriol and two parts of water, previously mixed. Half a pound of the mixture of black oxide and salt should be used for each hundred cubic feet of air in the room.

3. Enclose in a canvas bag as many pounds of chloride of lime as there are hundreds of cubic feet in the room to be fumigated, and immerse this in a vessel containing an equal weight of hydrochloric or sulphuric acid, diluted with three times its bulk of water.

When large rooms require fumigation, these methods, especially the last, are much more

cumbrous than fumigation by sulphur. Chlorine gas is irritating to the lungs when present in too great quantity. The choking sensation thus occasioned may be relieved by the inhalation of the vapour of alcohol.

The disinfecting power of chlorine is universally acknowledged, and Braidwood and Vacher found that vaccine lymph, exposed to chlorine vapour, was invariably rendered inert. Chlorine and the following chlorinated compounds cannot be used in conjunction with sulphurous acid, as they are mutually destructive.

Euchlorine is a mixture of chlorine and chlorous acid, and is useful in maintaining the purity of the air of the sick chamber. It is obtained by dropping crystals of chlorate of potassium into strong hydrochloric acid. It is evolved more abundantly if the saucer containing the mixture is heated by placing it in warm water, but this must be carefully done, as it is liable to explode if too great heat be applied.

Chlorozone is a patented disinfectant, consisting of an alkaline permanganate combined with an alkaline hypochlorite and chloride. It gives off slowly chlorine and ozone. I am not aware of any exact experiments showing its value, nor do I see any advantage it possesses over other chlorinated compounds.

Chloride of Lime (*Chlorinated Lime*, *Bleaching*

Powder) is prepared by saturating slaked lime with chlorine gas. It is variable in strength, but should contain about 30 per cent. of chlorine. If exposed to the air it parts with chlorine slowly if dry, more rapidly if moist, still more rapidly if moistened with a weak acid, such as vinegar, whilst with a stronger acid, such as hydrochloric or sulphuric, it gives off so much chlorine as to be unbearable in the sick room. It may be used as an aerial disinfectant, by standing it about the room in saucers moistened with vinegar and water. It may be used also in the dry state for sprinkling over offensive accumulations, and in close-stools and vessels which receive discharges from the patient. It is also sometimes employed in water for disinfecting linen, but is not to be recommended for this purpose, as it has considerable bleaching power, and if used of sufficient strength to be efficient as a disinfectant proves very destructive to the fabric.

The liquid preparations of chloride of lime and chloride of soda, manufactured by *Beaufoy* and others, are good preparations, but weaker than the solid chloride. Some preparations analysed by Dr. Stevenson contained only about 3 per cent., whilst *Labarraque's solution* contained only $\frac{1}{9}$ per cent. *Eau de Javelle*, much used in France, is a similar potash compound.

These chlorinated compounds are poisonous, but

owing to their acrid taste and powerfully caustic action on the lips and tongue are hardly likely to be taken in sufficient quantity to cause serious injury.

Bromine is similar in action to chlorine, but less efficacious, and more expensive. Its vapour also is very irritating when breathed. It is used in the form of a solution of bromine in bromide of potassium, which is exposed in open dishes, from which the bromine is slowly given off into the air.

Iodine has been employed as a disinfectant, but is somewhat expensive, and when used, as frequently recommended, by placing the solid iodine about the room, it evaporates too slowly to be efficient. It may be made to evaporate more rapidly by placing it on a hot plate; but a great objection to its use in this way is that it condenses so readily about the room, instead of remaining in the form of vapour, and that it stains everything on which it condenses, though the stain is not usually permanent.

The remark under "chlorine," as to the irritating properties of the gas, and the relief of this irritation by inhaling the vapour of alcohol, applies equally to the vapours of bromine and iodine.

Hydrochloric Acid is inferior to chlorine as *an aerial disinfectant*, but its solution is useful

for disinfecting linen and the excreta of the patient; for this purpose the strong hydrochloric acid of commerce is mixed with water in the proportion of one ounce to a pint. It is objected to for use in water-closets, as if allowed to stand in the closet pan it is liable to corrode the fittings. It may, however, be used for cleansing the trap and soil-pipe, if the closet is flushed with pure water afterwards. Other acids have been employed in a similar way, but do not possess any special advantages. *Glacial aromatic vinegar* is a pleasant cleansing agent to add to the water used for sponging the skin in infectious cases.

All the strong acids are very poisonous. If taken in error, common whiting stirred up in water, so as to suspend it, should be freely administered.

Braidwood and Vacher found that vaccine lymph exposed for two hours to hydrochloric acid gas was rendered inert.

In olden times *vinegar* had a great repute as a disinfectant, but its efficacy was much overrated.

Carbolic Acid (*Phenol, Phenic Acid*).—This substance, which is formed abundantly during the distillation of coal, has given rise to much discussion as to its value as a disinfectant. It is, however, probably one of the most practically useful of disinfectants, and for this purpose Calvert's No. 5 acid leaves little to be desired.

The usual strength is about one part of this acid in 80 to 100 parts of water, well shaken or stirred up—*i.e.*, a fluid ounce of the acid* may be mixed with half a gallon of water. This solution may be used standing about the rooms in saucers, and for sprinkling floors, carpets, etc.; sheets soaked in it may be suspended about rooms, from which it evaporates into the air, and it forms an excellent solution for soaking infected linen (which should remain in it twenty-four hours), as it does not injure the fabric or the colour. It may also be used for flushing drains and water-closets. A solution of twice this strength may be employed for vessels destined to receive the excreta. Dr. Tripe found that 2 per cent. of carbolic acid (No. 5) destroyed all the infusoria and bacteria in sewage, and Braidwood and Vacher found that vaccine lymph mixed with solution of carbolic acid was rendered inert; but Dr. Dougall, of Glasgow, found that such vaccine regained its activity after exposure to the air had allowed the carbolic acid to evaporate. Hence any substances submitted to the action of carbolic acid should not be considered as finally disinfected—*e.g.*, linen immersed in carbolic solution should be afterwards washed *and boiled;* and carbolic acid vaporized by heat, as sometimes recommended for fumigating purposes, should not

* *The bottles* are conveniently marked in fluid ounces.

be relied on. But if this peculiarity in its action be borne in mind, it is one of the most valuable agents we possess in arresting the spread of disease.

Carbolic acid is decomposed by chlorine, and decomposes Condy's fluid; therefore these substances should not be used in conjunction with it. It does not injure linen, clothing, etc., but should not be allowed to fall on polished furniture or varnished surfaces. If the pure acid is dropped on the skin, the part should be well rubbed with oil *previous* to washing.

It is very poisonous, many deaths having occurred from taking it. If swallowed, olive oil should be taken immediately, and watery drinks avoided. To obviate the risk of poisoning in some degree, Messrs. Calvert have prepared it in solid blocks, one of which is placed in the closet, or in the vessel used for receiving excreta, and slowly dissolves. The danger of poisoning is also obviated by the use of *carbolic powders*, which are made by several manufacturers, and sold under various names. For many purposes they are inferior to the acid itself, but are extremely useful for disinfecting drains, cesspools, manure accumulations, etc. They are efficient if freshly prepared, and may be extemporized by mixing ten parts crude acid with 100 parts of any absorbent substance, such as sawdust, clay, or

lime. *Calvert's carbolic powder* contains 15 per cent. of carbolic acid. *McDougall's powder* consists of calcium carbolate and magnesium sulphite, and is a very useful and cheap disinfectant, and this year a patent has been obtained for a soluble form of this powder.

Pyridine is a new disinfectant, consisting of carbolic and cresylic acids and creasote, combined with organic alkaloids (pyridine bases). I know of no experiments to indicate its real value.

Cresylic Acid (*Cresol*) is, like carbolic acid, a product of the distillation of coal. It is said to be more powerful than that agent, but is not much used. It is contained in the crude carbolic acid of commerce.

The disinfecting power of tar-water, and the fumes of coal tar, depend in a great part on the carbolic and cresylic acids they contain.

Jeyes' Perfect Purifier is a patented disinfectant of the coal-tar series. It is recommended for use for the same purposes as carbolic acid, diluted with water in the proportion of one part "purifier" to 100 parts of water. I am not aware of any exact experiments to determine its value as a disinfectant, but it has been highly recommended, and containing, as it does, carbolic and cresylic acids and other coal-tar products, it doubtless *possesses* considerable power. *Jeyes' Sanitary*

Powder is similar in character, and may be used in the same way as carbolic powder.

Camphor is popularly supposed to be a disinfectant, but this belief rests on no good foundation. Braidwood and Vacher found that vaccine lymph, exposed under a bell-receiver for five days to the vapour of camphor, was perfectly active.

Iron Salts.—*Sulphate of Iron* (*Ferrous Sulphate, Copperas, Green Vitriol*) is an efficient and cheap disinfectant, useful for disinfecting drains, water-closets, cesspools, manure and refuse heaps, etc., for which purpose it should be used as a concentrated solution, four pounds of the salt being dissolved by stirring in a gallon of hot (not boiling) water, it being more readily soluble in water at 194° F. (90° C.) than at the boiling-point. When used to disinfect the contents of cesspools, one pint of this solution should be employed to each cubic foot of contents. It is poisonous in large doses, but its taste generally prevents sufficient being taken to prove dangerous.

Perchloride of Iron (*Ferric Chloride*) may be used in a similar way, a pint of the strong solution of iron of commerce being diluted with a gallon of water.

Iron salts are not suitable for disinfecting the air of the sick-room, as they are not volatile, nor is it advisable to use them in the house for

any purpose, as they produce stains on anything they touch, familiarly known as "iron-moulds."

Zinc Salts.—These salts are similar in action, and are cheap and efficient disinfectants. The chloride is the one chiefly used, being sold as *Sir Wm. Burnett's Disinfecting Fluid*, which is a solution of chloride of zinc, containing about twenty-five grains to the fluid drachm, and slightly acid. This fluid, diluted with eight times its bulk of water, may be used for purifying drains and cesspools, and placing in water-closets, close-stools, etc., for which purpose no disinfectant is more applicable; but not being volatile, it is of little or no use as an aerial disinfectant. It may be used, still more diluted, for soaking linen, etc., previous to being washed, the proper strength for this purpose being an ounce and a half of Burnett's fluid in a gallon of water. If used too concentrated the fabric suffers. The great drawback to its employment is its extremely poisonous nature, several fatal cases having been recorded. The best antidote is the administration of a solution of phosphate of soda, largely diluted, which forms an insoluble phosphate of zinc. Demulcent drinks, such as gruel, barley water, etc., should also be given. Dr. Tripe found that 2 per cent. of Burnett's fluid destroyed all infusoria and bacteria in sewage.

Sulphate of Zinc (*White Vitriol*) may be used

in a similar way, two pounds of the salt being dissolved in a gallon of warm water for cesspools, etc. For linen the suitable strength is four ounces of the solid sulphate dissolved in three gallons of water.

Aluminium Salts.—A solution of *chloride of aluminium* is sold under the name of *chloralum;* it is non-poisonous, inodorous, and cheap. Its action is similar, but probably weaker than that of the iron and zinc salts; its real value, however, as a disinfectant has yet to be determined. In the hands of Braidwood and Vacher it failed when mixed with an equal quantity of vaccine lymph to destroy its activity.

Chloralum acts injuriously on metals when undiluted. It is generally used in the proportion of one part of chloralum to eight of water. A weak solution, about four ounces in a gallon, may conveniently be used for washing furniture, etc.

Aluminium Sulphate is recommended by Professor Béilstein as effective and cheap, in combination with a little carbolic acid.

Potassium Permanganate is a good, but if used in the necessary quantity is not a cheap, disinfectant. It is extremely useful in the sick room, but not being volatile is not suitable for aerial disinfection. It also stains linen, etc., if employed of sufficient strength to be efficacious. It may,

however, be used for all other purposes, and not being poisonous in fairly diluted solutions is an excellent disinfectant for drinking vessels, etc. If the salt itself is used, it should be dissolved in water in the proportion of an ounce or an ounce and a half to a gallon. It is more generally, however, used as *Condy's Fluid*, which is a solution of this salt, the red fluid containing about eight grains of permanganate in the fluid ounce. To be thoroughly efficient, therefore, this fluid should only be diluted with an equal volume of water. Braidwood and Vacher found that permanganate of potassium was destructive to the specific properties of vaccine lymph; and Dr. Tripe found that it was necessary to add Condy's fluid to sewage in the proportion of 1 to 33 before the movements of the infusoria and bacteria ceased; and Dr. Baxter found that "the proportion of permanganate required to destroy the infective energy of vaccine lymph is relatively large." The *green* fluid consists of manganate of potassium, and should only be used for drains, cesspools, etc.

Chloride of Lead is recommended as an excellent deodorant, and is prepared by dissolving half a drachm of nitrate of lead in a pint of boiling water, and two drachms of common salt in a pail of water, mixing the two solutions, and allowing the precipitate to subside. The clear *supernatant* liquid is used by dipping cloths in it,

and hanging them about the room. Employed in this way it is very cheap, and has some effect as a deodorant, but it is far too dilute to be a reliable disinfectant.

The *waste chlorides* from the manufacture of chlorine are cheap and useful for disinfecting manure accumulations, cesspools, etc.

Sanitas is a patent disinfectant, prepared by the oxidizing action of a blast of hot air driven through oil of turpentine. It is not poisonous, and is agreeable in odour; it is said to contain peroxide of hydrogen and camphoric acid. It is sold in three forms—sanitas fluid, sanitas oil, and sanitas powder, the last being slaked lime mixed with the oil. The fluid, oil, and powder may all be used to stand about the sick room, and to place in vessels to receive excreta, and linen may be soaked in sanitas fluid (No. 2) diluted with an equal quantity of water. Its position as a disinfectant has yet to be determined; but it is spoken favourably of by many medical officers of health. Dr. Tripe, however, found that 1 per cent. of sanitas fluid did not destroy the living organisms contained in sewage.

Terebene is obtained by the action of oil of vitriol on oil of turpentine, and has been recommended as a disinfectant, and was found by Braidwood and Vacher to destroy the potentiality of vaccine lymph. It was also found by Dr.

Lane Notter to have a very decided action on bacteria.

Lime is only of practical use as a disinfectant in the form of lime-wash, which is a valuable cleansing agent, and to which carbolic acid may be advantageously added in the proportion of an ounce in half a gallon. Lime, too, forms the basis of various disinfecting powders; being used as an absorbent of more active disinfectants.

Disinfecting Soaps are useful in many ways, principally for disinfecting the patient's body, and for cleansing wood, paint, furniture, etc. Many varieties are made, such as carbolic soft soap (useful for furniture, wood, etc.), carbolic household soap, carbolic toilet soap, sanitas soap, tar soap, sapo carbonis detergens. Of these, none excel the carbolic soaps, which, however, should be made by some responsible manufacturer, whose name guarantees that they contain a really useful amount of carbolic acid. Calvert's toilet soap contains 10 per cent. of the acid, and McDougall's about 7 per cent.

CHAPTER VI.

LEGISLATION.

THE concluding chapter of this book may fitly be occupied by the consideration of the nature and extent of the checks to the spread of infectious diseases, authorized or imposed by law in this country. And the first essential provision which would enable a sanitary authority to deal effectively with an outbreak of infectious disease is wanting, viz., early notification of the fact that such disease exists. Too frequently the first intimation of its existence is given to the medical officer of health or the sanitary authority, by the perusal of the death-register. Many towns have recognized this evil, and have obtained powers, by means of local Acts of Parliament, to demand such notification of infectious diseases; but there are obvious objections to such piecemeal legislation. Why should Mr. Smith, living ten yards beyond the boundary of such

local authority, have the existence of infection in his family concealed, whilst Mr. Brown, his next-door neighbour, just inside such boundary, has the fact of such infection existing reported to the medical officer of health, and is carefully looked after. Justice requires that both should be dealt with alike, and that, if notification is necessary, it should be universal. That it is necessary, the voice of the medical profession, and particularly of that section of it who have specially studied sanitary science, proclaims; but how should it be done? The local Acts, of which I have spoken, as a rule make it the duty of the medical attendant to notify the fact of the existence of infectious disease to the sanitary authority or their medical officer of health. But this course is open to such grave objections that, if possible, another solution should be found. It is distasteful to the profession, as it involves a breach of that confidence between doctor and patient, which they have always held inviolable, and which it is the interest of all classes to preserve intact; and it not unfrequently contributes directly to the spread of infection, since it creates a tendency amongst many to avoid or delay sending for a doctor when they suspect an infectious disease, knowing that he is required to report such cases; and thus the

"Disease, unknown to men,
Creeps, no precaution used, among the crowd."

Truly, we are more careful of our cattle than we are of human life, for from the Contagious Diseases (Animals) Act we may gather the mode of action necessary—make it obligatory on the head of the household to report such diseases to the sanitary authority, just as he would cattle plague or foot-and-mouth disease, and let it be his duty to ascertain whether any disease from which his household suffers is infectious or not. It may be wise, as a subsidiary portion of the scheme, to make it the duty of the medical man to acquaint the head of the family formally with the fact of such disease existing whenever he may be called in, but the true principle, in my opinion—and in this I know I re-echo only the almost unanimous voice of our profession—is to make the responsibility of reporting to the sanitary authority rest where it naturally does, on the head of the family, and let the working of the Act I have mentioned testify that this is no visionary scheme.

If a person, suffering from infectious disease, exposes himself in the streets, or otherwise, to the danger of others, he is a nuisance, and indictable as such at common law; but proceedings by indictment are slow and expensive, and therefore this is a proceeding rarely had recourse to, the real check against wilful exposure of infected persons resting in the provi-

sions of the Public Health Act, 1875, which I shall briefly recapitulate, referring the reader to the Act itself for more detailed information. And, in quoting the provisions of this Act, I would premise that the *local authority* for carrying out the Act consists of the Town Council in the case of Boroughs, the Improvement Commissioners of an Improvement Act District, the Local Board of a Local Government District, or the Board of Guardians elsewhere—except in the Metropolis, which is subject to its own special Acts of Parliament and Board of Works.

Sections 46 and 120 provide for the cleansing of filthy and infected houses, section 46 reading thus:—"Where, on the certificate of the medical officer of health, or of any two medical practitioners, it appears to any local authority that any house,* or part thereof, is in such a filthy or unwholesome condition that the health of any person is affected or endangered thereby, or that the white-washing, cleansing, or purifying of any house, or part thereof, would tend to prevent or check infectious disease, the local authority shall give notice, in writing, to the owner or occupier of such house, or part thereof, to whitewash, cleanse, or purify the

* Interpretation clause:—"'House' includes schools, also factories and other buildings in which more than twenty persons are employed at one time."

same, as the case may require." The penalty for neglecting this notice is not to exceed ten shillings per day, and the local authority may cleanse the house and recover the expenses so incurred from the person in default.

Section 120 is similar, but conveys still further powers. It runs thus:—"Where any local authority are of opinion, on the certificate of their medical officer of health, or of any other legally qualified medical practitioner, that the cleansing and disinfecting of any house, or part thereof, and of any articles therein likely to retain infection, would tend to prevent or check infectious disease, it shall be the duty of such authority to give notice, in writing, to the owner or occupier of such house, or part thereof, requiring him to cleanse and disinfect such house, or part thereof, and articles within a time specified in such notice." A similar penalty is attached to disobedience, and a similar power of carrying out the necessary cleansing, at the defaulter's expense, is given; but the termination of the clause provides:—

"Where the owner or occupier of any such house, or part thereof, is from poverty or otherwise unable, in the opinion of the local authority, effectually to carry out the requirements of this section, such authority may, without enforcing such requirements on such owner or occupier,

with his consent, cleanse and disinfect such house, or part thereof, and articles, and defray the expenses thereof."

Sections 84 and 86 provide for the notification of the occurrence of infectious diseases in common lodging-houses* to the sanitary authority in the following terms:—

"The keeper of a common lodging-house shall, when a person in such house is ill of fever, or any infectious disease, give immediate notice thereof to the medical officer of health of the local authority, and also to the poor law relieving officer of the union or parish in which the common lodging-house is situated." For failing to do so, the Act imposes a penalty not exceeding five pounds, and "a further penalty not exceeding forty shillings for every day during which the offence continues."

Section 121 provides for the destruction of infected articles:—

"Any local authority may direct the destruction of any bedding, clothing, or other articles which have been exposed to infection from any dangerous infectious disorder, and may give compensation for the same."

Sections 122, 123, 131, and 141 give power

* A common lodging-house is a house for the reception of people of the poorer classes, in which several persons, not *belonging all to* one family, sleep in a common room.

to local authorities to provide a proper place, with necessary apparatus and attendance for the disinfection of bedding, clothing, and infected articles; carriages suitable for the conveyance of persons suffering from infectious diseases; hospitals for their reception and treatment; and a mortuary for the reception of dead bodies before interment.

Section 124 provides:—

"Where any suitable hospital or place for the reception of the sick is provided within the district of a local authority, or within a convenient distance of such district, any person who is suffering from any dangerous infectious disorder, and is without proper lodging or accommodation, or lodged in a room occupied by more than one family, or is on board any ship or vessel, may, on a certificate signed by a legally qualified medical practitioner, and with the consent of the superintending body of such hospital or place, be removed, by order of any justice, to such hospital or place at the cost of the local authority; and any person so suffering, who is lodged in any common lodging-house, may, with the like consent, and on a like certificate, be so removed by order of the local authority."

Sections 126 to 129, relating to wilful exposure of infected persons and things, disinfection of carriages, and letting infected houses, are so important that I quote them *in extenso*:—

"126. Any person who—

"(1) While suffering from any dangerous infectious disorder, wilfully* exposes himself without proper precautions against spreading the said disorder in any street, public place, shop, inn, or public conveyance, or enters any public conveyance without previously notifying to the owner, conductor, or driver thereof that he is so suffering; or

"(2) Being in charge of any person so suffering, so exposes such sufferer; or

"(3) Gives, lends, sells, transmits, or exposes, without previous disinfection, any bedding, clothing, rags, or other things which have been exposed to infection from any such disorder,

shall be liable to a penalty not exceeding five pounds; and a person who, while suffering from any such disorder, enters any public conveyance without previously notifying to the owner or driver that he is so suffering, shall, in addition, be ordered by the court to pay such owner and driver the amount of any loss and expense they may incur in carrying into effect the provisions of this Act with respect to disinfection of the conveyance.

"Provided that no proceedings under this section shall be taken against persons transmitting with proper precautions any bedding,

* *i.e.*, knowingly.

clothing, rags, or other things for the purpose of having the same disinfected."

"127. Every owner or driver of a public conveyance shall immediately provide for the disinfection of such conveyance after it has, to his knowledge, conveyed any person suffering from a dangerous infectious disorder; and if he fails to do so he shall be liable to a penalty not exceeding five pounds; but no such owner or driver shall be required to convey any person so suffering until he has been paid a sum sufficient to cover any loss or expense incurred by him in carrying into effect the provisions of this section.

"128. Any person who knowingly lets for hire any house, room, or part of a house in which any person has been suffering from any dangerous infectious disorder, without having such house, room, or part of a house, and all articles therein liable to retain infection, disinfected to the satisfaction of a legally qualified medical practitioner, as testified by a certificate signed by him, shall be liable to a penalty not exceeding twenty pounds.

"For the purposes of this section, the keeper of an inn shall be deemed to let for hire part of a house to any person admitted as a guest into such inn."

"129. Any person letting for hire or showing for the purpose of letting for hire, any house or

part of a house, who, on being questioned by any person negotiating for the hire of such house or part of a house, as to the fact of there being, or within six weeks previously having been therein any person suffering from any dangerous infectious disorder, knowingly makes a false answer to such question, shall be liable, at the discretion of the court, to a penalty not exceeding twenty pounds, or to imprisonment, with or without hard labour, for a period not exceeding one month."

Sections 130 and 134 empower the Local Government Board to make special regulations in times of cholera and formidable epidemic, endemic, or infectious disease, and section 142 makes provision for the disposal of the bodies of those who have died of infectious diseases, in the following terms :—

"Where the body of one who has died of any infectious disease is retained in a room in which persons live or sleep, or any dead body which is in such a state as to endanger the health of the inmates of the same house or room is retained in such house or room, any justice may, on a certificate signed by a legally qualified medical practitioner, order the body to be removed, at the cost of the local authority, to any mortuary provided by such authority, and direct the same to be buried within a time to be limited in such *order; and* unless the friends or relations of the

deceased undertake to bury the body within the time so limited, and do bury the same, it shall be the duty of the relieving officer to bury such body at the expense of the poor rate; but any expense so incurred may be recovered by the relieving officer in a summary manner from any person legally liable to pay the expense of such burial. Any person obstructing the execution of an order made by a justice under this section shall be liable to a penalty not exceeding five pounds."

Another important means of effectually dealing with one infectious disease (small-pox) is contained in the Vaccination Laws, under which any child or person may be vaccinated at the public expense, on application to the public vaccinator of the district in which he resides, and any adult may claim re-vaccination if the available supply of lymph is sufficient for that purpose. Every child born in England is compelled to be vaccinated within three months of its birth, with the following exceptions:—

1. If the child be in such a state of health as not to be in a fit state for vaccination, it may be postponed by a certificate from a legally qualified medical practitioner, such certificate to be renewed every two months, until the child is fit to be vaccinated.

2. If the child be resident in a sparsely inhabited district in which the public vaccina-

tions are performed only at stated intervals, say of three or six months, it is sufficient that the child be vaccinated at the first public vaccination after it has attained the age of three months.

3. If the child, having been unsuccessfully vaccinated at least three times by a legally qualified medical practitioner, be certified by such practitioner to be insusceptible to vaccination.

4. If the child have already suffered from small-pox.

It will thus be seen that the powers given to sanitary authorities in dealing with outbreaks of infectious disease are numerous and varied, but in some respects they are defective—*e.g.*, no power exists whereby a school in which infectious disease exists can be closed in order to prevent the spread of such disease. But is such a power desirable? I have already expressed my opinion as to the undesirability of breaking up schools which receive boarders; but is it equally undesirable to close day-schools? In my opinion, this depends entirely on the circumstances of the case, and I look upon the absence of such power as a decidedly injurious omission in the Public Health Act. My experience as a medical officer of health has led me to the conclusion that in these days of *compulsory* education, school attendance is often

the means of propagating an infectious disease. The contact of children in school is so close, and for several hours daily they are together in a somewhat confined atmosphere, that if infection be present, it is almost sure to spread. My advice is then to exclude from attendance at school, all children who are suffering, or have suffered, from infectious disease, and all who reside in the same house with them, and to continue this exclusion in the case of children of the poorer class, in whom proper disinfection cannot usually be relied on, until a fortnight has expired longer than the periods mentioned in Chapter III., as those during which infection continues; and this process of exclusion should be carefully carried out so long as only few cases occur, but that if after so doing the disease continues to spread, and there is reason to suppose that slight cases may have been overlooked and allowed to continue attendance, then it is advisable to close the school entirely.

This omission in the Public Health Act has been remedied, so far as public elementary schools are concerned, by a regulation contained in the Code of the Committee of the Privy Council on Education; but as regards schools not under Government inspection, it appears the sanitary authorities are powerless. This regulation makes

it a condition of a grant being given to a public elementary school, that "the managers must comply with any notice of the sanitary authority of the district in which the school is situated, requiring them, for a specified time, with a view to preventing the spread of disease, either to close the school, or to exclude any scholars from attendance, subject to an appeal to the department, if the managers consider the notice to be unreasonable."

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